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Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This report results from a contract tasking RFAF Institute of Aerospace Medicine as follows: The contractor will duplicate for the solar research branch of the air force a tip-tilt mirror system including the drive electronics, recently developed by KIS for use at its solar telescope on Tenerife.

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Report on contract SPC-96-4004

Project: Tip/Tilt Mirror for Image Motion Compensation

Principal Investigator: Wolfgang Schmidt, Kiepenheuer-Institut für Sonnenphysik

Date: 3 May 1996

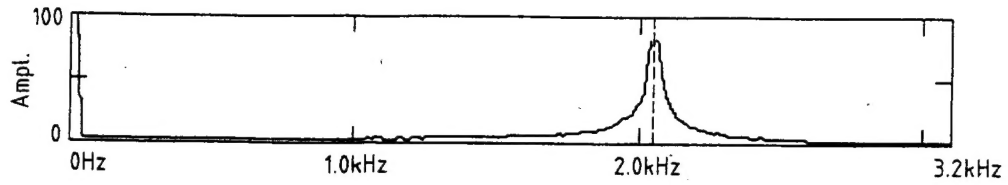
1. Project Description

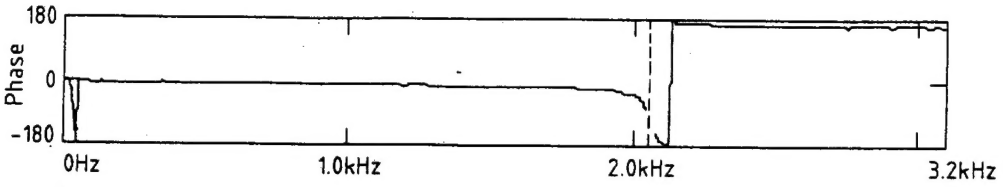
The present investigation is part of the continued cooperation between the Solar Research Branch of the Air Force Phillips Laboratory (Pl/GPSS), the National Solar Observatory (NSO) and the Kiepenheuer-Institut (KIS). The KIS, in cooperation with the Instituto de Astrofísica de Canarias (Spain) has recently developed a second generation Image Motion Compensation System. The corresponding high-speed tip-tilt mirror system has been built at the KIS.
Within the present contract, the KIS has duplicated the tip-tilt mirror, including all mechanical and electrical parts and adapted the size of the mirror and its housing to the usage foreseen at Sacramento Peak. The KIS has also verified the performance of the mirror system in its laboratory at Freiburg.
After completion of the tests the equipment has been shipped to the U.S. on 20 March 1996, in cooperation with the Ramstein AFB. The mirror arrived the the Sacramento Peak Observatory a few days later. Drs. Rich Radick and Thomas Rimmele have sent the following statement about the first tests performed at Sacramento Peak:

> *The Kiepenheuer tip-tilt mirror an electronic drive system was shipped via Federal Express from Ramstein AFB on 20 March 1996, and arrived at Holloman AFB a few days later. It had been well packed, and was delivered without damage. Initial tests at Sacramento Peak indicated that it was operating properly. Extensive tests performed over the following month showed that the mirror's performance is exactly as promised and expected. The documentation is complete and thorough. We are currently working toward incorporating this mirror into the Mark II correlation tracker system being developed at Sacramento Peak, and expect this system to come on line by the end of the summer. Overall, PL/GPSS is very pleased with the performance of the Kiepenheuer Institut in completing this contract.*
>
> *Dr. Richard R. Radick, PL/GPSS, Solar Research Branch*
> *Dr. Thomas Rimmele, Project Scientist, National Solar Observatory*

2. System Performance

The first resoncance of the 40 mm mirror setup occurs at 2000 Hz, and the phase shift remains close to zero below the resonance frequency. The following Bode diagram illustrates this performance. This unit is well suited for fast closed-loop digital or analog servo systems. The large frequency range and the undelayed amplitude response guarantees negligible impact on the bandwidth of such a system.





3. Concluding Remarks

We hope to continue this cooperation, especially in the area of Active Optics, but also in other fields of solar research. Once again I want to express my gratitude to the European Office of Aerospace Research and Development for their financial support.

Freiburg, 3 May 1996

Wolfgang Schmidt